explosion-puffed apples are commercially feasible

R. L. Stabile, V. A. Turkot, N. H. Eisenhardt and J. Cording, Jr.

Agricultural Research Service, U.S.D.A./Philadelphia, Pa.

EXPLOSION puffed, dehydrated fruit and vegetable pieces possess a highly porous structure. This attribute gives the puffed material quick-cooking properties in contrast to the slow rehydration of conventional air-dried pieces of equal size. Another advantage is a crisp texture, which in apple lends itself readily to use as a snack item. Cost estimates for a commercial plant designed to produce dehydrated explosion puffed apple segments are presented.

Process of explosion puffing has been described in earlier publications. Briefly, it involves heating diced or sliced product while tumbling it inside a sealed rotating cylindrical gun. When temperature and pressure inside the gun have risen to a predetermined level, the gun is fired by releasing a quick-opening lid at one end of the cylinder, and the contents are discharged. Upon release of pressure, part of the superheated water within each piece flashes into steam and creates a porous internal structure in the piece. This porous structure permits rapid hot air drying of the puffed pieces to low moisture contents, and enables rapid rehydration of the dried pieces when placed in water.

For apples, 10 pounds of pieces partly dried to about 15 per cent moisture are loaded into the gun. Superheated steam injected inside the gun directly on the apple pieces supplies heat. A gas flame against the outer wall of the gun prevents condensation of water on the inner wall. In about 30 seconds, pressure inside the gun is built up to about 25 psig and is held at this level for another 30 seconds before firing. Thus, 20 10-pound charges an hour can be puffed per gun.

Basic Assumptions for Cost Estimate

The explosion puffing plant is to be an addition to an existing apple processing plant, located in an apple producing area of the northeastern United States. Processing season would begin with harvesting of the fall crop and run for about six months. Other available commodities could be processed during the remaining months to reduce the fixed costs per unit of product. However, unless a multiproduct plant is designed initially, the plant for apples would require some modification to produce other explosion puffed products.

Manufacture of explosion puffed apple slices would be undertaken by a company which already prepares sliced apples in some form, such as canned, frozen, dehydrofrozen, 24 per cent moisture slices or low moisture slices. Processing facilities for the puffed slices would be physically located at the plant where fresh slices are prepared. Existing facilities would be used to prepare and deliver slices to the explosion puffing operation. Preparation of slices would consist of peeling, coring, trimming, slicing and screening to remove slivers, bits of carpel tissue, etc.

The cost of slices as they enter the puffing process from the existing plant slice line, is charged in this estimate at 6.4 cents per pound. This figure is based on use of York Imperial apples.

There will be three puffing guns in the plant. Two would normally be in operation while the third would be a spare to enable continued operation if one gun is undergoing repairs or maintenance.

As an addition to an existing plant, the puffing operation would use certain facilities already present. These include land, steam boiler, fork lift truck, loading pallets, warehouse space, and office equipment. Prorated costs for sharing of these facilities are charged against the puffing process under the heading of "rent".

The plant will operate five days a week, 128 operating days a year. Two shifts (15¼ hours) of production per day is assumed. Capacity of the plant is taken as 3,816 pounds of raw apples per hour or 58,194 pounds per operating day. Product rate is 352 pounds per hour of 2.5 per cent moisture apple segments. Thus, out-

Table I. Equipment Summary

Equipment	Description-Cost
1. Feed Hopper Conveyor	To receive apple slices from plant and feed them at constant rate to sulfiter (No. 3). Stainless steel hopper and contact parts, neoprene belt ½ hp variable speed drive, 12-in-wide belt, about 4-ft discharge height. Hopper to hold about 1,000 lb of slices. Cost: $2,200.
2. Sulfite Feed	To feed concentrated sodium bisulfite solution to the sulfiter (No. 3) to maintain 2 per cent concentration of sodium bisulfite. 100 gal stainless steel tank, with 1 gpm pump using 1/8 hp motor, including 1/3 hp agitator. Solution feed rate is approximately 0.25 gpm. Cost: $1,400.
3. Sulfiter	To immerse slices for approximately 5 minutes in a 2 per cent sodium bisulfite solution to prevent darkening and spoilage. Parts contacted by liquid made of stainless steel. 3/4 hp variable speed drive. 1/3 hp agitator for tank. Cost: $8,300.
4. Drip Pan	To collect excess water as slices pass overhead on conveyor (No. 5) to dryer. Approximately 5-ft long by 18-in wide, stainless steel, with drain pipe connected to sulfiter. Cost: $300.
5. Conveyor	To transfer slices from sulfiter to spreader. 5-ft long by 12-in wide belt of mesh type to permit water to drain to drip pan, 1/4 hp drive. Cost: $500.
6. Spreader	To uniformly distribute slices over dryer belt. 2-1/3 hp total. Cost: $5,000.
7. Preliminary Dryer	To dry approximately 2,500 lb per hour of slices from 86 per cent to 15 per cent moisture. Continuous through circulation conveyor dryer, approximately 53-ft long. Air heated by steam coils. Total power load of about 73 hp. Cost: $55,000.
8. Equilibration Bins	To store slices from preliminary dryer for approximately 16 hr in order to evenly distribute moisture among the slices. Fiberglass reinforced plastic with cover. About 27 cu ft and holding about 400 lb of slices. Ten are required. Cost: $1,700.
9. Dumper	To elevate bins (No. 8) and dump slices into blender (No. 10). About 15 ft dumping height, lifting capacity about 1,200 lb. 1½ hp motor. Cost: $2,300.
10. Conical Blender	To mix slices with anti-caking powder. Holds slices from one full bin. Mixing time about 15 minutes. Stainless steel 3 hp drive. Cost: $3,800.
11. Feed Hopper	To provide uniform feed rate to conveyor (No. 12). Vibrating type, with gate, stainless steel. Cost: $600.
12. Conveyor	To carry slices to feed hoppers (No. 13) above gun loading platform. Rubber belt type with cleats for elevators and distributing deflectors to hoppers. 1½ hp motor. Cost: $4,000.
13. Feed Hoppers	To feed slices to puffing guns. Three required. Capacity approximately 30 cu ft each. Chute on outlet to measure volumetrically the charge to the gun. Cost: $3,000.
14. Puffing Guns	Three required; two operating and one spare. Equipped for steam injection. Each gun system complete and independent, including gun proper, steam superheating system (electrical), indicator-recorder for gun pressure, indicator-recorder-controller for gun surface temperature (controls gas flame) indicator-recorder for superheated steam temperature. Cost: $41,700.
15. Gun Discharge Tunnels	Two required. To receive slices shot from guns and deliver them to feed hopper (No. 16). Tunnel about 3 ft in diameter by approximately 25-ft long and inclined about 25° above the horizontal. Aluminum and stainless steel construction. Cost: $7,800.
16. Feed Hopper	To collect slices from tunnels and feed them at a uniform rate to conveyor (No. 17). Stainless steel hopper, 45 cu ft, with gate, and vibratory feeder. Electric vibrator using 15 watts. Cost: $800.
17. Conveyor	To feed slices from feed hopper (No. 16) to the spreader (No. 18) of the final dryer. Rubber belt type, about 20-ft long. 1 hp. Cost: $1,200.
18. Spreader	See Spreader, item No. 6. Cost: $5,000.
19. Final Dryer	This dryer is similar to the Preliminary Dryer (No. 7). Operating rate is 420 lb per hr of 19 per cent (wet basis) moisture slices. The final moisture of the slices is 2.5 per cent. Dryer has 10½-ft wide belt and 24½-ft long main body. Total power load 35.5 hp. Cost: $30,000.
20. Inspection Table	For final inspection of slices and manual removal of defects. Rubber belt conveyor approximately 10-ft long by 24-in wide belt. ½ hp motor. Cost: $1,700.
21. Conveyor	To transfer slices to feeder (No. 22), above packaging machine. Neoprene belt, 12-in wide by about 20-ft long, with cleats and side boards. 1 hp drive. Cost: $1,700.
22. Feeder	To feed slices to packaging machine (No. 23). Consists of 200 cu ft stainless steel hopper with rotary vane type feeder, ½ hp. Cost: $3,200.
23. Packaging Machine	To package slices at rate of 5 to 18 packs per minute. Each package contains one pound. Slices to be packed in printed laminated film under nitrogen atmosphere. Resulting oxygen content in package to be 2 per cent (by vol.) or less. Nitrogen requirement is 0.40 cu ft per lb of product packed. Machine automatically feeds and weighs pieces into bags which are flushed with nitrogen and sealed. Unit complete with all instrumentation—nitrogen metering device, oxygen analyzer to indicate continuous oxygen concentration, and weigh scale controls. 7 hp. Cost: $49,000.
Total Cost of Equipment	$230,200

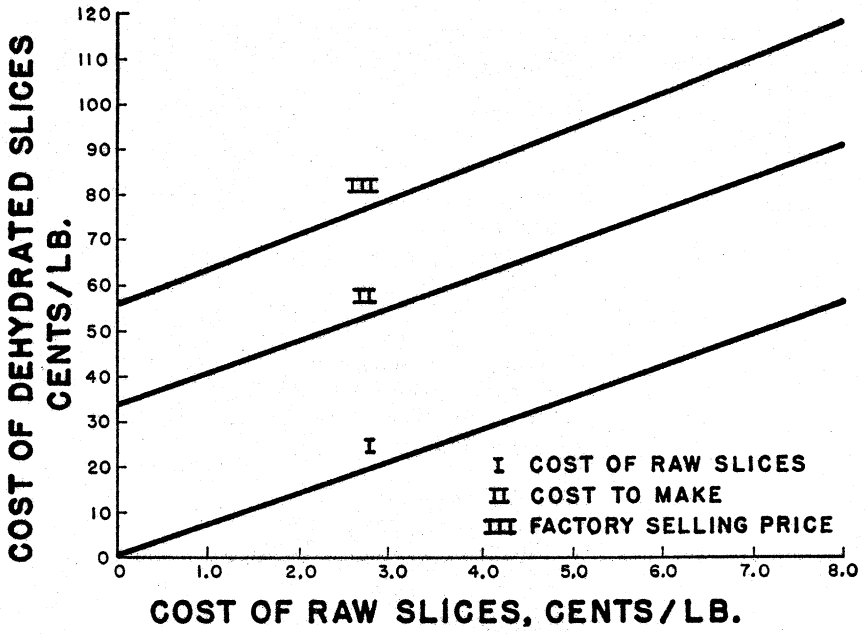

Figure 1. Variation of factory selling price and manufacturing costs in relation to cost of raw slices.

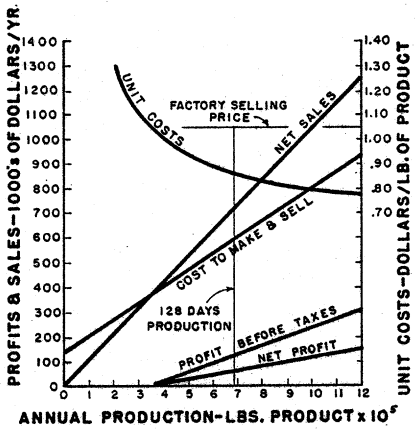

Figure 2. Variation of annual sales, costs, and profits with annual production rate. "Unit Costs" curve is cost to make and sell per pound of dehydrated slices.

put is 5,368 pounds per day or 687,104 pounds per season.

Plant output for two guns and two-shift operation for 128 days is approximately one per cent of the total U.S. production of apple slices in all forms. Compared to U.S. production of low moisture apple, the output is estimated as about 10 per cent, on the low moisture (2.5 per cent) weight basis. Annual output of the plant also is approximately equivalent to current annual purchases of low moisture apples by the U.S. military services. It is assumed that explosion puffed apples will be sold for institutional use and chiefly for making pies.

Packaging will be plastic laminated film bags containing one pound of product in nitrogen gas. Storage life in this package is expected to be approximately one year at 70°F. The contents are equivalent to one No. 10 can of wet slice pack. Compared to a can, the plastic bag offers a savings in space and disposal cost to the user. Also, a savings in production cost of approximately 4.4 cents per pound of product results from using plastic bags instead of No. 10 cans. An alternative bulk pack could be a plastic lined fiber drum which holds 75 pounds of dried slices. This package would reduce packaging cost by about 5 cents per pound of slices compared to the individual one-pound bag.

Cost Estimates

Table I presents a list of the major items of processing equipment required, together with a description of each item and its estimated price. Prices are as of fourth quarter 1969.

Table II presents various "physical asset" components involved in setting up the plant to make explosion puffed dehydrated apple slices, together with their estimated costs. Estimated total fixed capital is shown, also working capital and estimated total capital.

Table III presents individual cost items which comprise the total cost of running the plant. These items of cost are shown both as dollars per day of plant operation and as cents per unit (pound) of dried final product. Summation of these items gives the total daily cost of operating the plant as well as factory selling price per pound of product.

Table IV lists those "fixed asset" items which are assumed to be already in existence at the existing apple processing plant, and which also will be used by the explosion puffing plant. No cost figure for these items is entered under Capital Costs (Table II), but a daily charge against the explosion puffing plant for their use is computed here and entered into Table III, Operating Costs, under "rent".

Table V, Financial Analysis, lists the several items of sales, costs, profits, etc., on the overall annual basis.

Discussion and Conclusions

Plant design and cost estimates as developed here indicate that a profitable commercial plant for producing dried explosion puffed apple segments is possible. Selling price at the indicated production rate is competitive with existing low-moisture dried apple products. The latter, when packed in No. 10 cans, are approximately 0.6 cent per pound less than the price developed here. This small price difference may be due to the difference in cost of raw apples used. Figure 1 shows that a change of one cent per

Table II. Capital Costs

	Dollars
1. Site preparation, roads, parking area, railroad siding, fences.	3,500
2. Buildings-processing 4,240 sq ft, includes lighting, heating, fire protection system.	63,500
3. Equipment - manufacturing (see Table I).	230,200
4. Equipment erection-manufacturing; 15% of No. 3.	34,500
5. Instruments; 2% of No. 3.	4,600
6. Piping and ductwork, including materials and labor for installation; 11% of No. 3.	25,300
7. Power-installed-113.5kw	22,700
8. Insulation of steam lines.	2,300
9. Freight on equipment; 2% of No. 3.	4,600
10. Contingencies; 10% of total.	50,800
11. Engineering fees; 10% of total.	50,800
12. Contractor's fees; 3% of total	15,200
13. Total fixed capital.	508,000
14. Working capital.	127,000
15. Total capital.	635,000

Table III. Operating Costs

15-1/4 hours production per day, 5 days per week, 128 days per year, 352 lb. product per hour at 2.5 per cent moisture, 5368 pounds per day, 687,104 lb. per year.

	Cost/Day Dollars	Cost/Pound of Product Cents
I. Factory Manufacturing Costs		
A. Direct Production Costs		
1. Raw materials		
a. Apple slices to process, 37,668 pounds per day @ 6.4¢/pound	2410.75	44.91
b. Sodium bisulfite, 261 pounds/day at 9.5¢ per lb	24.80	.46
c. Zeolex-7, (anti-caking powder) 78 pounds per day at 9.5¢ per pound	7.41	.14
Total raw materials	2442.96	45.51
2. Packaging materials		
a. Plastic laminated and printed film bags, 1.00 lb product per bag, 5368 bags per day @ 8.43 cents per bag	452.52	8.43
b. Cartons, 12 bags per carton, 448 cartons per day @ 13.9¢	62.27	1.16
Total packaging materials	514.79	9.59
3. Operating labor. 6 men per shift, two shifts per day	288.00	5.36
4. Indirect labor	23.00	.43
5. Maintenance and repairs, 3% of fixed capital per year	119.06	2.22
6. Operating supplies, 10% of (5)	11.91	0.22
7. Utilities		
a. Steam, approximately 40,000 lb per day @ $0.80 per 1000 lb	69.31	1.29
b. Electricity, approximately 1780 KW-hr per day @ 1.2¢ per KW/hr	21.38	0.40
c. Gas, approximately 780 cu ft per day @ $0.50 per 1000 cu ft	0.39	0.48
d. Nitrogen, approximately 2150 cu ft per day @ $1.20 per 100 cu ft	25.77	0.48
e. Water, 2750 GPD @ $0.20 per 1000 gallons	0.55	0.01
Total utilities	117.40	2.19
Total direct production costs (A) sum of 1 to 7	3517.12	65.52
B. Fixed Charges		
8. Insurance, 1 percent of fixed capital per year	39.69	0.74
9. Taxes (real estate), 1.5 percent of fixed capital per year	59.53	1.11
10. Depreciation, straight line, 45 yr. bldgs. 12 yr. equipment	293.44	5.47
11. Rent (see details in Table IV)	75.61	1.41
Total fixed charges (B) (sum of 8 to 11)	468.27	8.73
C. Plant Overhead costs		
12. Non-wage payments: Social Security, workman's compensation, unemployment insurance, vacation pay—20% of total labor	62.20	1.16
13. Laboratories	5.00	0.09
14. Waste disposal	5.00	0.09
Total plant overhead (C) (sum of 12 to 14)	72.20	1.34
Total Factory Manufacturing Expense (I) (Sum of A, B and C)	4057.59	75.59
II. General Expense		
D. Interest on Working Capital, $127,000 at 8% per year	79.38	1.48
E. Research and Development 0.5% of gross sales	28.13	0.52
F. Administration and General, 15% of total labor, maintenance and repair, and operating supplies	66.30	1.24
Total General Expenses (II) (Sum of D to F)	173.81	3.24
III. Cost to Make (Sum of I and II)	4231.40	78.83
IV. Selling Cost, 7% of gross sales	393.76	7.34
V. Cost to Make and Sell (Sum of III and IV)	4625.16	86.17
VI. Profits and Discounts ($476.25 + $28.13) (12%/year profit on fixed capital, 0.5% of gross sales for discounts)	504.38	9.39
VII. Income Taxes	495.69	9.23
VIII. Selling Price (Sum of V, VI, and VII)	5625.23	104.79

pound in the cost of the raw apples changes the selling price by eight cents per pound of dried product. Effect of annual production level on profit and unit costs may be seen in Figure 2. By increasing production 15 per cent beyond that indicated here, unit production cost is reduced approximately three cents per pound of product. Therefore, a three cent reduction in selling price would be possible.

Explosion puffed, dehydrated fruit and vegetable pieces possess a highly porous structure. This attribute gives the puffed material quick cooking properties in contrast to slow rehydration of conventional air-dried pieces of equal size. Another advantage is a crisp texture, which in apple lends itself readily to use as a snack item. Also, explosion puffed apple segments make excellent pies.

Based on economics of the plant design and selling price, an opportunity for a profitable venture exists if an adequate market for explosion puffed apple can be drawn from the areas of competing products and from new areas such as snacks.

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Table IV. Rental Charge

	Land	Boiler	Warehouse Equipment	Pallets	Warehouse Building	Office Equipment
Size or Description	4500 sq ft	5000 lb/hr	Fork Lift Truck	1143	1800 sq ft	
Cost, $	450	21,800	7,000	11,430	20,200	3,500
Charges, %/yr						
Interest	8	8	8	8	8	8
Taxes	2	2	2	2	2	2
Insurance	0	1	1	1	1	1
Depreciation	0	4	10	25	3	8
Maintenance	5	6	5	5	4	3
Total %	15	21	26	41	18	22
Annual Cost, $	67.50	4,580	1,820	4690	3640	770
Rent for Season, $	67.50	2330	1210	3130	2430	510

Total Rent = $9678.00 per year

Rent per day = $75.61

Table V. Financial Analysis

(128 operating days per year)

1. Gross Sales	$720,029
2. Returns, Allowances, Discounts	3,600
3. Net Sales (1 minus 2)	716,429
4. Product Cost ($4,057.59 x 128 days)	519,372
5. Gross Annual Profit (3 minus 4)	197,057
6. Administration, Interest on Working Capital, Selling Expense, Research	72,649
7. Profit before Taxes (5 minus 6)	124,408
8. Income Taxes	63,448
9. Net Profit	60,960
10. Earned on Fixed Capital	12.00%
11. Dollar Sales per Dollar Fixed Capital	1.417
12. Profit per lb. of Product	$0.08872
13. Cash Flow:	
Net Income	$60,960
Depreciation	37,560
Total	$98,520
14. Payout time: ($508,000/$98,520/yr) = 5.15 yrs.	

tables. (U.S. Patent No. 3,038,813.)

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Heiland, W. K. and Eskew, R. K. 1965. A new gun for explosive puffing of fruits and vegetables. U.S. Agr. Res. Serv. ARS 73-47, 8 pp.

Sinnamon, H. I., Eskew, R. K. and Cording, J., Jr., 1965. Dehydrated explosion-puffed carrot dice of high density. U.S. Agr. Res. Serv. ARS 73-50, 6 pp.

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For more information write to authors at U.S. Department of Agriculture, Agricultural Research Service, Eastern Utilization Research and Development Division, 600 E. Mermaid Lane, Philadelphia, Pa 19118

PARTIAL LIST OF MANUFACTURERS OF EQUIPMENT

The companies listed below supply equipment which can be used in making explosion puffed dehydrated apple pieces by the process described in this report. The item numbers refer to the flow sheet, Figure 1, and the Equipment Summary, Table I. Reference to these companies does not imply endorsement of them by the Department of Agriculture over other companies not mentioned, and failure to list other companies is not intentional.

1. Feed Conveyor

A. K. Robbins & Co., Inc.
713 East Lombard Street
Baltimore, Maryland 21202

Blaw-Knox Co.
Food and Chemical Equipment Division
1543 Fillmore Avenue
Buffalo, New York 14211

The Bucket Elevator Co.
24 Commerce Street
Chatham, New Jersey 07928

2. Sulfite Feed System

Tank: Any supplier of standard equipment

Tank Agitator:

Chemineer, Inc.
P.O. Box 1000C
Dayton, Ohio 45401

Mixing Equipment Co., Inc.
219 Mt. Read Boulevard
Rochester, New York 14603

Nettco Corp.
81 Tileston Street
Everett, Massachusetts 02149

Metering Pump:

Chemcon, Inc.
10 Industrial Park
Medfield, Massachusetts 02052

Milton Roy Co.
P.O. Box 12169
St. Petersburg, Florida 33733

Yarway Corp.
Blue Bell, Pennsylvania 19422

3. Sulfiter

A. K. Robbins Co.
713 East Lombard Street
Baltimore, Maryland 21202

FMC Corp.
Canning Machinery Division
333 West Julian Street, Box 1120
San Jose, California 95108

Overton Machine Co.
407 South Front Street
Dowagiac, Michigan 49047

4. Drip Pan: Any local fabricated sheet metal supplier

5, 12, 17, 21. Conveyors and Elevators

The Bucket Elevator Co.
24 Commerce Street
Chatham, New Jersey 07928

Paul Mueller Co.
P.O. Box 828
Springfield, Missouri 65801

Edward Renneburg & Sons Co.
2639 Boston Street
Baltimore, Maryland 21224

Blaw-Knox Co.
Food & Chemical Equipment Division
1543 Fillmore Avenue
Buffalo, New York 14211

A. K. Robbins & Co., Inc.
713 East Lombard Street
Baltimore, Maryland 21202

6, 18. Spreader (See 8, 20, Dryers)

7, 19. Dryers*

National Drying Machinery Co., Inc.
Lehigh and Hancock
Philadelphia, Pennsylvania 19133

Proctor & Schwartz, Inc.
7th and Tabor Road
Philadelphia, Pennsylvania 19120

Ross Engineering Division
Midland-Ross Corp.
P.O. Box 147
New Brunswick, New Jersey 08903

C. G. Sargent's Sons Corp.
Graniteville, Massachusetts 01829

8. Equilibration Bins

Goodyear AerospaceCorp.
Akron, Ohio 44315

Fusion Rubbermaid Corp.
Statesville, North Carolina 28677

Union Steel Products Co.
Albion, Michigan 49224

9. Dumper

Conveyors & Dumpers, Inc.
Division of Mercury Industries, Inc.
P.O. Box 98
Park Ridge, New Jersey 07656

Essex Conveyors, Inc.
101 Calden Street
Newark, New Jersey 07103

Tubar Products
Division of Uhrden, Inc.
Sugarcreek, Ohio 44681

10. Blender

Paul O. Abbe, Inc.
141 Center Avenue
Little Falls, New Jersey 07424

* It may be possible to use other types of dryers such as the following:
1. Vertical agitated tray dryer, such as the Turbo-Dryer manufactured by the Wyssmont Company, Inc., Fort Lee, New Jersey 07024.
2. Rotary Dryer, such as the Roto-Louvre dryer manufactured by Link-Belt Division of FMC Corp., Chicago, Illinois.

Patterson Division
Patterson Industries, Inc.
East Liverpool, Ohio 43920

The Patterson-Kelly Co., Inc.
Process Equipment Division
East Stroudsburg, Pennsylvania 18301

11, 13, 16, 22. Feed Hoppers

Hoppers: Any local supplier of fabricated sheet metal

Feeders:

Syntron
Division of FMC Corp.
Homer City, Pennsylvania 15748

Acrison, Inc.
180 Broad Street
Carlstadt, New Jersey 07072

Beaumont Birch Co.
1527 Race Street
Philadelphia, Pennsylvania 19102

BIF, Division of General Signal Corp.
345 Harris Avenue
Providence, Rhode Island 02901

Vibra Screw, Inc.
755 Union Boulevard
Totowa, New Jersey 07512

14. Puffing Guns

Wilmot Fleming Engineering Co.
Hasbrook below Cottman Street
Philadelphia, Pennsylvania 19111

15. Discharge Tunnels

Blueprints for fabrication may be obtained from USDA, ARS, EU,
Engineering and Development Laboratory
600 East Mermaid Lane
Philadelphia, Pennsylvania 19118

20. Inspection Table

Chisholm-Ryder Co., Inc.
Drawer F
Bridge Station
Niagara Falls, New York 14305

A. K. Robbins and Co., Inc.
713 East Lombard Street
Baltimore, Maryland 21202

FMC Corp.
Canning Machinery Division
333 West Julian Street
Box 1120
San Jose, California 95108

23. Packaging Machine

Mira-Pak, Inc.
7000 Ardmore
P.O. Box 14049
Houston, Texas 77021

Bartelt Engineering Co., Inc.
Subsidiary of Riegel Paper Corp.
1900 Harrison Avenue
Rockford, Illinois 61108

The Woodman Co., Inc.
114 New Street
Decatur, Georgia 30030

The Wright Machinery Co.
Division of Sperry Rand Corp.
P.O. Box 2211
Halloway and Calvin Streets
Durham, North Carolina 27702

LEGENDS FOR FIGURES

Figure 1: Flow Sheet of Process for Making Dehydrated Explosion-Puffed Apple Slices.

Figure 2: Variation of Factory Selling Price and Manufacturing Costs in Relation to Cost of Raw Slices.

Figure 3: Variation of Annual Sales, Costs, and Profits with Annual Production Rate. "Unit Costs" Curve is "Cost to Make and Sell" per Pound of Dehydrated Slices.

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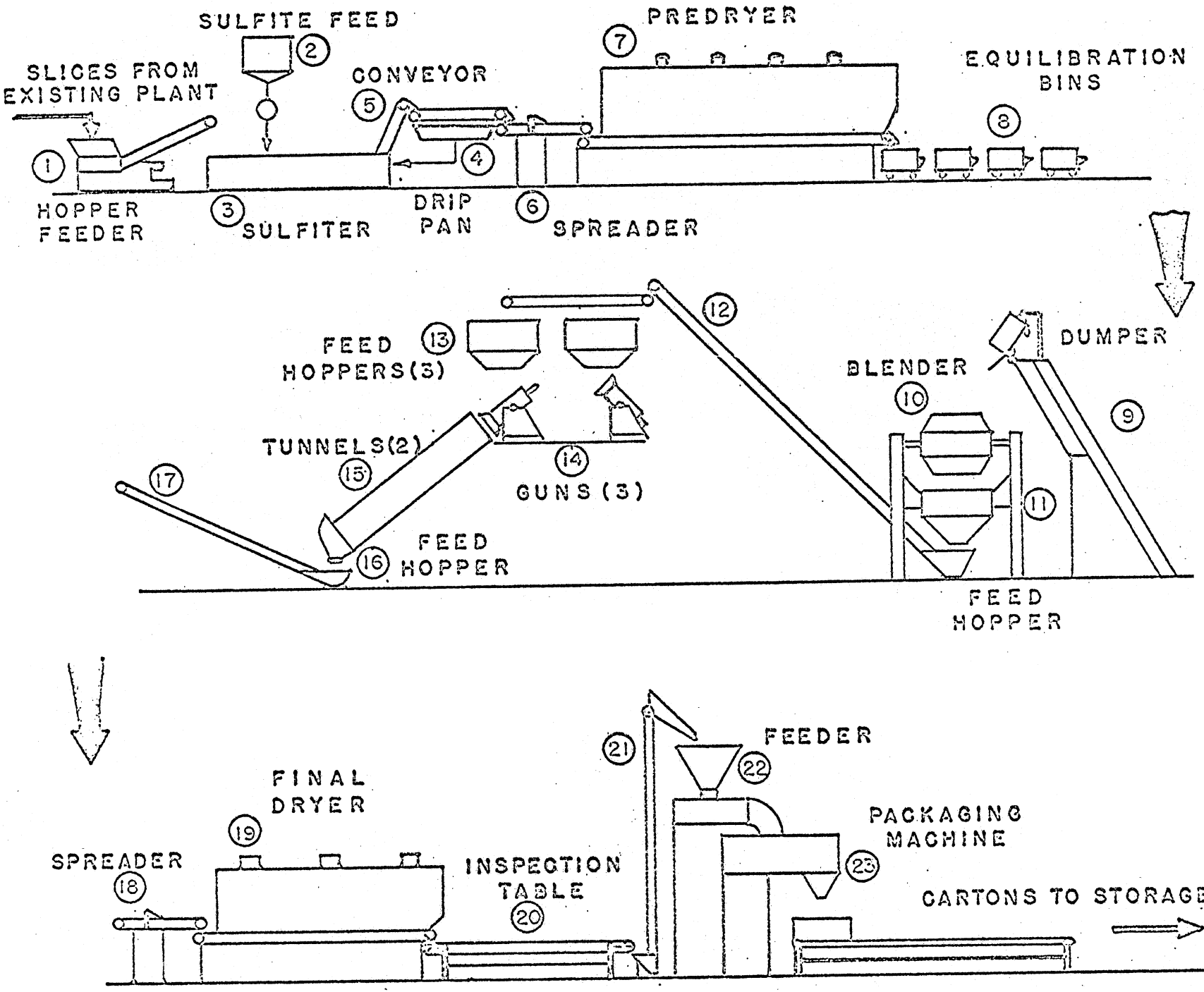
SULFITE FEED
2
PREDRYER
7
SLICES FROM EXISTING PLANT
CONVEYOR
5
EQUILIBRATION BINS
8
1
4
HOPPER FEEDER
3
SULFITER
DRIP PAN
6
SPREADER
12
FEED HOPPERS(3)
13
DUMPER
BLENDER
10
9
TUNNELS(2)
15
14
GUNS (3)
17
11
FEED HOPPER
16
FEED HOPPER
21
FEEDER
22
FINAL DRYER
19
PACKAGING MACHINE
SPREADER
18
INSPECTION TABLE
20
23
CARTONS TO STORAGE